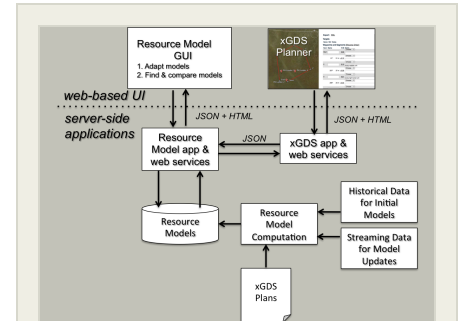# Adaptive Resource Estimation and Visualization for Planning Robotic Missions, Phase I

Completed Technology Project (2015 - 2016)

Project Introduction

NASA's future human exploration missions will include remotely operated rovers performing surface exploration and science, as well as free-flyers to reduce the need for human Extra Vehicular Activity (EVA). As astronauts move deeper into space, it will be necessary for them to manage these robotic assets with less support from ground controllers. A flexible approach is needed to build and revise plans for semi-autonomous robots. A key requirement for such planning operations is the ability to accurately predict how much resource (e.g., time, power) is needed to perform planned tasks. TRACLabs and CMU propose to develop software to model resources for use in building and revising plans for semi-autonomous robots. The resource models will be used to estimate the duration of planned tasks based on historical plan performance. They will be updated periodically during a mission to improve model accuracy at a site. This software also will be used to provide actual resource data for annotating a map of the site when building. The resource modeling software will be designed for evaluation with the IRG Exploration Ground Data System planning software. Improved resource modeling produces more accurate predictions of the resources needed for planned tasks. More accurate resource estimates improves the likelihood that plans can be executed "as planned". When plans don't go as expected, these resource models can be used to determine how to modify robot plans within available resources. This should reduce the human workload needed to revise robot plans during plan execution and, when revisions are needed, to determine which subset of activities can actually be completed with remaining resources. Such resource modeling technology is enabling for remote operation and supervision of planetary robots with variable levels of autonomy (NASA Roadmap TA4).

Adaptive Resource Estimation and Visualization for Planning Robotic Missions, Phase I
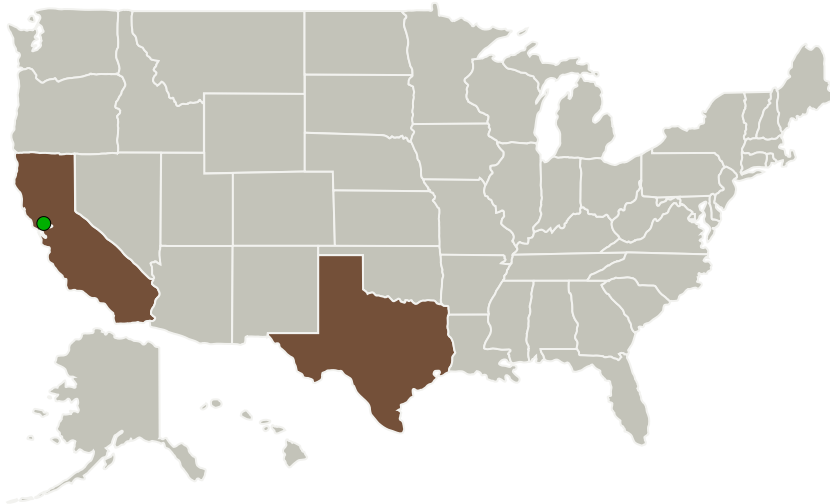
Table of Contents

Primary U.S. Work Locations and Key Partners

Organizations Performing Work	Role	Type	Location
TRACLabs, Inc.	Lead Organization	Industry	Webster, Texas
🟢 Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Carnegie Mellon University	Supporting Organization	Academia	Pittsburgh, Pennsylvania
Carnegie Mellon University - Silicon Valley	Supporting Organization	Academia	Moffett Field, California

Primary U.S. Work Locations	
California	Texas

Project Transitions

▶ **June 2015:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

TRACLabs, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
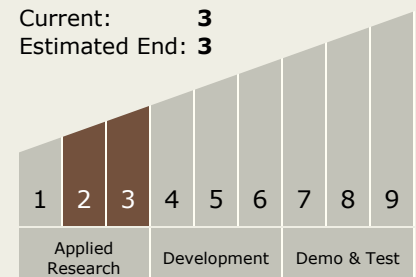
Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Debra L Schreckenghost

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**

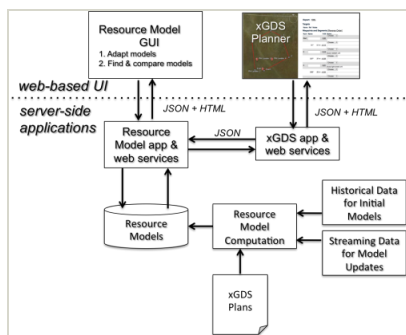| 1	2	3	4	5	6	7	8	9
Applied Research			Development			Demo & Test		

✔ **June 2016:** Closed out

Closeout Summary: Adaptive Resource Estimation and Visualization for Planning Robotic Missions, Phase I Project Image

Closeout Documentation:
- Final Summary Chart Image*(https://techport.nasa.gov/file/138655)*

Images

Briefing Chart Image
Adaptive Resource Estimation and Visualization for Planning Robotic Missions, Phase I
(https://techport.nasa.gov/imag e/132218)

Technology Areas

Primary:

- TX10 Autonomous Systems
  └ TX10.2 Reasoning and Acting
    └ TX10.2.2 Activity and Resource Planning and Scheduling

Target Destinations
The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System